

Weights & Measures Quarterly

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WMD Moves On!

On Friday, September 8, WMD will move to permanent offices on the main campus at NIST. Almost ten years ago, several divisions at NIST, including WMD, were moved off-campus to a location that quickly became known as NIST North while renovations took place in some of the out-of-date buildings on the main campus. The buildings were gutted, the asbestos removed, the facilities modernized, and now it is time to head back to campus. This move will provide the staff with better access to NIST services--the metrology laboratory, the library, the cafeteria, printing and duplicating, the travel office, training rooms, etc.

All phone numbers and addresses will remain as they are now, however, access to the main campus is more difficult because of security regulations. If you are planning a trip to NIST, please give the person you are visiting adequate notice to register you with the Visitor's Center.

We're Listening!

Letter to the Editor

(Letter published as received)

Over the years, NIST WMD (formerly NBS OWM) has in many instances, "self-amended" the Organic Act (in the part where it states; to work with the states "in securing uniformity in weights and measures laws and methods of inspection.") by changing a key word in this Congressional mandate, substituting the word "promote" for the word "securing". Once again (Hi! My Name is

Carol... Vol. 9 No. 2, June 2006) in this latest newsletter, the switch occurs.

Although some may regard this as semantics or "nitpicking", I would argue that there is a critical difference between "advocating" (promote) and "making it happen" (securing) when it comes to achieving uniformity amongst the states.

I believe WMD "shortchanges" their responsibility to this mandate by employing this wording. NIST may choose to promote metrics, international metrology and a host of other hot-button institutional goals, but they must always be held accountable to their mandate of securing uniformity right here in the United States.

I sincerely welcome WMD Chief Carol Hockert and wish her well in this important position. The dedicated WMD staff contributes greatly to the cause of "uniformity", but their resources have consistently been reduced. Whereas subsequent WMD budgets will determine the future of secured uniformity, NIST management must be made to appreciate their responsibility. Maybe the W & M regulatory community is at fault for not lobbying both Congress and NIST to provide the resources to "making uniformity happen". The NCWM has been the primary mechanism used by NIST to fulfill its responsibility, first as the sponsor and now in collaboration. I encourage Chief Hockert to foster this collaborative, which I believe is the best vehicle to achieve our common goal of national uniformity.

Robert M. McGrath
Sealer of Weights and Measures
City of Boston

Response from Carol Hockert, Chief, WMD

Thank you for your comments on my article where I introduced myself to the weights and measures community. I assure you that my plan is to foster collaboration between NIST and the NCWM in order to make use of resources in the most efficient manner towards our goal of strengthening the weights and measures infrastructure in the United States. These are my words, as were the words in my previous article, and you can rest assured that I was not quoting the Organic Act at the time.

Having said that, I thought I would clarify the obligations of NIST and, therefore, WMD so that you and others may understand why the division spends its resources in the areas it does. First of all, the Organic Act reads:

“(b) The Secretary of Commerce (‘Secretary’) acting through the Director of the Institute (‘Director’) and, as appropriate, through other officials, is authorized to take all actions necessary and appropriate to accomplish the purposes of this Act, including the following functions of the Institute— ...

(9) to assure the compatibility of United States national measurement standards with those of other nations;

(10) to cooperate with other departments and agencies of the Federal Government, with industry, with State and local governments, with the governments of other nations and international organizations, and with private organizations in establishing standard practices, codes, specifications, and voluntary consensus standards; ...

(c) In carrying out the functions specified in subsection (b), the Secretary, acting through the Director and, if appropriate, through other appropriate officials, may, among other things—...

4) cooperate with the States in securing uniformity in weights and measures laws and methods of inspection.”

I have only quoted those sections pertaining to WMD, but the Organic Act can be

read in its entirety at <http://www.nist.gov/director/ocla/organic.htm>.

As you can see from the above text, NIST has no authority or obligation to do more than “cooperate with the States” in securing uniformity in weights and measures. “Cooperating” with the States is but one of the ways that NIST “may” fulfill its mission. Because of States’ rights, WMD would be acting beyond its authority if we tried to secure uniformity on our own. The more difficult task is persuading the States that it is in their best interests to cooperate to achieve uniformity in weights and measures.

Looking at (9) and (10) above, NIST is also authorized “to assure the compatibility” (i.e., traceability) of U.S. measurement standards with those of other nations and “to cooperate with other departments...” in establishing standards. The work NIST does as a participant in OIML and other standards developing organizations (including NCWM) is in response to this part of the Organic Act. In fact, it is a critical aspect of promoting the growth of the U.S. economy through exports and imports. WMD also participates in OIML at the behest of the State Department in fulfillment of U.S. obligations under the OIML treaty.

WMD, however, has mandated responsibilities under the Fair Packaging and Labeling Act (FPLA), which reads:

“§1458. Cooperation with State Authorities; Transmittal of Regulations to States (a) A copy of each regulation promulgated under this chapter shall be transmitted promptly to the Secretary of Commerce, who shall (1) transmit copies thereof to all appropriate State officers and agencies, and (2) furnish to such State officers and agencies information and assistance to promote to the greatest practicable extent uniformity in State and Federal regulation of the labeling of consumer commodities.”

NIST WMD also carries out the Secretary of Commerce’s responsibilities under the Metric Conversion Law “to seek out ways to increase understanding of the metric system of measurement through education-

al information and guidance and in Government publications . . .” and under Executive Order 12770 “. . . to direct and coordinate efforts by Federal departments and agencies to implement Government metric usage in accordance with section 3 of the Metric Conversion Act (15 U.S.C. 205b), as amended by section 5164(b) of the Trade and Competitiveness Act.”

NIST is charged with advancing the metric system for the United States under the law, which defines the metric system as “the International System of Units (SI) as established by the General Conference of Weights and Measures in 1960 and as interpreted or modified for the United States by the Secretary of Commerce; . . .”

My point is that the Weights and Measures Division at NIST is expected to do more than just promote or secure uniformity in weights and measures laws and methods of inspection. We are committed to working with the NCWM, the States, and local jurisdictions towards uniformity. However, uniformity, like quality, is an evasive entity. We can move towards a more uniform system nationwide, but we can never achieve perfect uniformity. In order to determine if we are moving in the right direction, we need a clear definition and understanding of the current status and a way to measure progress. This issue will be covered in greater detail in a subsequent newsletter.

Publications Keep Pace with Technology

This year at the NCWM Annual Meeting in Chicago Chief of WMD Carol Hockert announced to the NCWM Board of Directors a change in the publication of the NCWM Annual Report. From the inception of the National Conference in 1905 to the present, NIST WMD has published the Conference’s Annual Report and other NCWM documents to assist the Conference disseminate information to its members and the weights and measures community in general. Those publications have always been prepared in hard copy at a cost of thousands of dollars to WMD. Alone, the publications are expensive to print; however, in recent years, the mailing costs have soared to

make the total cost of publication prohibitive.

The 2006 Annual Report will be prepared in DVD format and will be incorporated in the compiled NIST Special Publication 979, which includes annual reports from 1905 through 2005. The December 2006 edition will include the reports of the Conference from the 2006 Annual Meeting. The DVD is thoroughly searchable and printable, allowing anyone the opportunity to search in a matter of seconds any Conference decision or discussion on any topic brought before the Conference.

A very limited number of hard copies, printed on 8 1/2 x 11 paper, will be available from WMD on a first-come, first-served basis.

Realizing a tremendous savings in printing costs from the WMD annual budget allows WMD to focus its resources on other activities and programs that will benefit everyone associated with weights and measures. The 2006 edition of SP 979 will be mailed around the end of November. All members of the Conference, plus State Directors and City and County sealers, will receive the DVD.

If you have any questions, please e-mail Lynn Sebring at lynn.sebring@nist.gov.

... in the field

Agreement of Indications on Shift or Section Tests

By Rick Harshman

WMD frequently receives inquiries concerning the correct application of NIST Handbook 44 Scales Code, paragraph T.N.4.4. Agreement of Indications on Shift or Section Tests. The purpose of this article is to explain the intent of the paragraph and define its correct method of application.

History and Purpose of T.N.4.4.

Scales Code paragraph T.N.4.4. Shift or Section Tests was fashioned from Scales

Code paragraph T.1.8. Sectional Tests on Vehicle, Livestock, and Railroad Track Scales, which first appeared in Handbook 44 in 1977. Paragraph T.1.8. applied only to the results of section tests on vehicle, livestock, and railroad scales and was intended to limit the amount of error on scales having two-way traffic patterns. It addressed a primary concern that a weighing error of 0.4 % could result from weighing loaded vehicles in one direction and unloaded vehicles in the opposite direction on the same scale. In 1977 the maintenance tolerance applicable to these scales was ± 0.2 % of applied load; a 0.4 % weighing error could result if one end of a scale had a + 0.2 % error and the opposite end had a - 0.2 % error. Paragraph T.1.8. required the range of the results of the section test to agree to within the absolute value of the maintenance tolerance applicable to the applied test load.

T.1.8. Sectional Tests on Vehicle, Livestock, and Railroad Track Scales.-

The maximum deviation between indicated values on test load applied to individual sections shall not be greater than the absolute value of the maintenance tolerance applicable to that test load.

Scales Code Paragraph T.1.8.

(This Paragraph No Longer Exists in Handbook 44)

Paragraph T.1.8. was removed from Handbook 44 in 1985 and replaced with Paragraph T.N.4.4. However, because paragraph T.N.4.4. was part of the New Scales Format and Tolerances appearing in the 1985 version of the Handbook, it did not become enforceable until January 1, 1986. Paragraph T.N.4.4. expanded the provisions of T.1.8. to include, not only results of section tests on vehicle, axle-load and livestock scales, but also the results of shift tests, thus broadening the application of the requirement to other scale types. However, unmarked scales with less than 2000 scale divisions or more than 5000 scale divisions were exempt from having to comply. Consequently, the 1986 Handbook 44 version of paragraph T.N.4.4. applied to the results of section tests on all vehicle, axle-load, and livestock scales, as well as the results of shift tests on all marked scales, and those

remaining unmarked scales with more than 2000 total divisions or less than 5000 total divisions.

In 1987, the Specifications and Tolerances (S&T) Committee of the 72nd National Conference on Weights and Measures (NCWM) received a request to amend paragraph T.N.4.4. by limiting the application of the requirement to multiple-section scales. The NCWM voted to limit the application of the requirement to unmarked multiple-section scales and all marked scales, noting in the final report for that year that the test was a good one and should be maintained for marked scales. The S&T Committee indicated that one purpose of the requirement was to prevent a scale from having shift test errors at the extreme limits of tolerance. The tolerance on the range of shift test errors would allow scale accuracy to deteriorate somewhat without the scale going out of tolerance. In justifying why an exemption was granted for certain types of unmarked scales, the S&T Committee explained that it did not intend for the requirement to apply to unmarked bench, floor, and counter scales but believed it was an appropriate requirement for marked scales since these devices were manufactured and installed after the effective date of the new code. Paragraph T.N.4.4. as shown below has remained unchanged since 1988.

T.N.4.4. Shift or Section Tests. The range of the results obtained during the conduct of a shift test or a section test shall not exceed the absolute value of the maintenance tolerance applicable and each test result shall be within applicable tolerances.

(Added 1986)

Scales Code Paragraph T.N.4.4.

Two Separate Tolerance Applications

It is important to recognize that two separate applications of tolerance are specified by paragraph T.N.4.4. Under the provisions of this paragraph, a tolerance is to be applied to the range of results obtained during a shift or section test and to each individual shift or section test result. For this reason, the tolerance value applicable to the range of results may be different from the tolerance value applicable to each individual result. The reason these tolerance values may differ is because the

absolute value of maintenance tolerance is always applied to the range of shift or section test results, whereas applicable tolerance (i.e., maintenance or acceptance, whichever is being applied based upon Handbook 44, G-T.1. and G-T.2.) is applied to each individual shift or section test result. For example, acceptance tolerance would apply to the individual shift test results obtained from a scale that is being officially tested for the first time within 30 days of being placed into service. However, the absolute value of maintenance tolerance would apply to the range of the individual shift test results obtained from that scale.

Determining the Range of Results

The range of a set of numbers is the difference between the lowest and highest number displayed in the set. Determining the range of a set of numbers is a simple matter of subtracting the lowest number from the highest number. For example, given the following set of numbers: (+10, 0, 0, -10, -10, -10, and -20), -20 is the lowest and +10 is the highest. Therefore, to determine the range of this set of numbers, subtract -20 (the lowest number) from +10 (the highest number). The equation for determining the range of these two numbers is easily set up as follows:

$$\text{Range} = 10 - (-20)$$

Because subtracting a number is the same as adding its opposite, this equation may be restated in simpler form:

$$\text{Range} = 10 + 20 = 30$$

Thus, the range of the example set of numbers shown in parenthesis above is 30.

A real number line is useful in providing a visual display of range. Notice in Figure 1. that there are two points marked on the number line; one of which is the highest number in the example set of numbers provided above; and the other, the lowest number. The total distance between these two points, i.e., 30 intervals, equals the range.

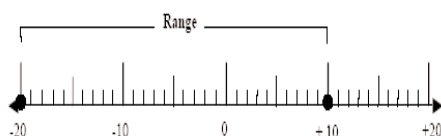


Figure 1. Range Displayed on a Number Line

Table 1 Example of Section Test Results: d = 10 lb

Load Position	Test Load Pounds	Scale Indication Pounds	Error Pounds	Within Maintenance Tolerance	Range of Results
Section 1	25 000	25 010	+ 10	Yes	40 lb
Midpoint	25 000	25 000	0	Yes	
Section 2	25 000	25 000	0	Yes	
Midpoint	25 000	24 990	- 10	Yes	
Section 3	25 000	24 990	- 10	Yes	
Midpoint	25 000	24 980	- 20	Yes	
Section 4	25 000	24 970	- 30	Yes	

Comparing Individual Shift or Section Test Results to Applicable Tolerances

To determine whether or not the individual results of the shift or section test comply with the provisions of T.N.4.4., each individual shift or section test result must be compared to applicable tolerance. To be compliant, no individual shift or section test result may exceed that tolerance. Applicable tolerance, as referenced by paragraph T.N.4.4., is the tolerance that is applied to a scale based upon the provision of GT.1. Acceptance Tolerances and GT.2. Maintenance Tolerances. For example, Table 1 depicts the results of a section test on a vehicle scale equipped with a 10 lb division. If the results shown in Table 1 had been obtained from a scale that had been in service for more than 30 days, maintenance tolerance would be the applicable tolerance.

To determine whether the individual section test results shown in Table 1 comply with T.N.4.4., each result must be compared to applicable tolerance. The Handbook 44 maintenance tolerance applicable to all vehicle scales, whether marked or unmarked, is one (1) division of allowable error for each 500 divisions of test load. Acceptance tolerance is one-half the maintenance tolerance values. Assuming the results shown in Table 1 were obtained from a scale that had been in service for more than 30 days and the minimum division size is 10 lb, the tolerance applicable to the 25 000 lb section test load would be ± 50 lb (i.e., maintenance tolerance, which is equal to one (1) division of error (10 lb) for each 500 divisions (5 000 lb) of test load). The acceptance tolerance applicable to this same test load would be ± 25 lb (i.e., one-half maintenance tolerance values).

From the results recorded in the shaded area of Table 1, it can be seen that no individual section test error exceeds the value of maintenance tolerance. It can therefore be concluded that the individual section test results are compliant with this particular provision of T.N.4.4. This would not be the case, however, if acceptance tolerances were being applied. If acceptance tolerances were being applied, no individual section result could exceed ± 25 lb (i.e., one-half maintenance tolerance values) and since the individual section result recorded for Section 4 is in excess of -25 lb, the scale would fail to conform.

Comparing the Range of Results to the Absolute Value of Maintenance Tolerance

To determine whether or not the range of results obtained during a shift or section test comply with the provisions of paragraph T.N.4.4., the range of the results must first be determined and then compared to the absolute value of the maintenance tolerance applicable to the test load.

Note: The absolute value of a tolerance is the value of that tolerance without considering the positive or negative sign. For example, whereas the maintenance tolerance applicable to a 25 000 lb test load applied to a vehicle scale with a 10 lb division size is ± 50 lb, the absolute value of that maintenance tolerance is 50 lb (that is, the number without the positive or negative sign). To help explain the intent of how paragraph T.N.4.4. is to be applied, Handbook 44 provides the following definition for the term absolute value.

absolute value. The absolute value of a number is the magnitude of that number without considering the positive or negative sign.[2.20]

The range of the individual section test results shown in Table 1 is determined by subtracting the lowest value (i.e., -30 lb) from the highest value (i.e., +10 lb) in the set. Using the same formula as described under 'Determining the Range of Results,' the range of the errors indicated in Table 1 is determined as follows:

$$\text{Range} = 10 - (-30)$$

When restated in simpler form, the equation becomes:

$$\text{Range} = 10 + 30 = 40$$

Because the range of the results of the section test is 40 lb and the absolute value of maintenance tolerance is 50 lb, the performance of the scale complies with this particular provision of T.N.4.4.

Summary of Results

The following summarizes how the provisions of paragraph T.N.4.4. are to be correctly applied to the results shown in Table 1:

1. If **maintenance** tolerances were being applied to the scale:
 - a. each individual section test result complies with applicable maintenance tolerances, and
 - b. the range of the results obtained during the section test are within the absolute value of the maintenance tolerance applicable to the test load.

Conclusion: Section test results comply with both provisions of T.N.4.4.

2. If **acceptance** tolerances were being applied to the scale:
 - a. each individual section test result does not comply with applicable acceptance tolerance, however,
 - b. the range of the results obtained during the shift test are within the absolute value of the maintenance tolerance applicable to the test load.

Conclusion: Section test results fail to comply with the provisions of T.N.4.4. because one individual section result exceeds applicable tolerance.

To receive additional information about this article, please contact Rick Harshman at 301-975-8107 or richard.harshman@nist.gov.

Inspecting and Testing Electronic Carcass Evaluation Devices

By Dick Suiter

This is the third in a series of W&M Quarterly articles intended to familiarize weights and measures field officials and administrators with electronic carcass evaluation device standards, operation, inspection, and testing. The first article, published in November 2005, discussed the four documentary standards applicable to electronic carcass evaluation devices during inspection and testing in the field. The second article, published in June 2006, described the Fat-O-Meat'er™ built by SFK Technology, Inc. This was the first device used by the U.S. pork-packing industry for measuring back fat and depth of the loin eye. This article and subsequent articles in the series will describe additional devices or systems currently in use commercially and others being used in non-commercial applications, but which have the potential for commercial use. For each device or system the articles will provide an overview of the base technology utilized and how the equipment functions, as well as test methods and reference material or physical standards currently available for use in conducting accuracy verification.

Since the 2006 edition of NIST Handbook 44 includes a new tentative code Section 5.59. Electronic Livestock, Meat, and Poultry Evaluation Systems and/or Devices-Tentative Code, it is important that field officials begin evaluating these devices to determine if any changes are needed to the tentative code.

In this article we will look at the AutoFom™ (automatic Fat-O-Meat'er) built by SFK Technology, Inc. This device utilizes ultrasonic energy of sound waves for measuring back fat and depth of the loin eye. The measuring principle used by the AutoFom™ is one of digitized, three-dimensional scanning. The scanning pattern is provided by 16 ultrasonic transducers embedded in a fixed stainless steel transducer array. The transducer array is located in a stainless steel trough. Carcasses are pulled or slid through the trough (Figure 1). As the carcasses pass over the transducer array (Figures 2 & 3),

the transducers provide a cross-section image for every 5 mm in the length of each carcass. Each of the 16 transducers produces approximately 200 measurements for a total of approximately 3200 measurements for the average carcass. By sampling all 200 measurements from one transducer, it is possible to produce a slice of the carcass in the length direction. Sampling the slices from all 16 transducers provides a three-dimensional image of the back side of the carcass (Figure 3).

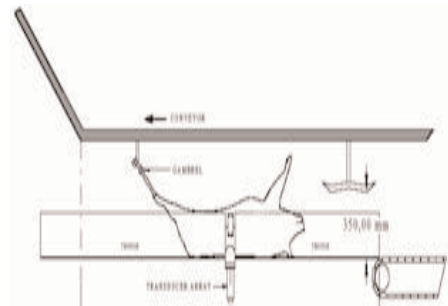


Figure 1

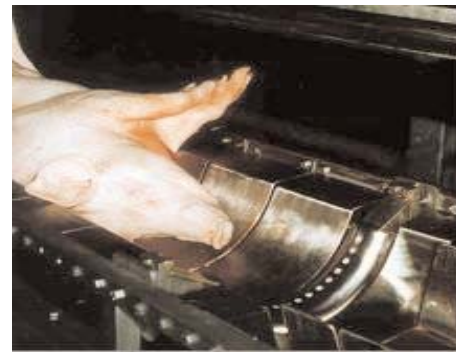


Figure 2

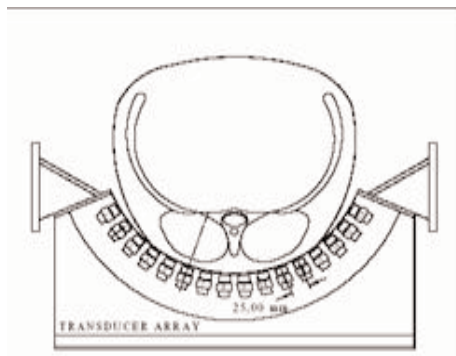


Figure 3

From the three-dimensional image, (Figure 4) the system software determines, indicates, and records measurements of the external fat thickness and the loin muscle thickness.

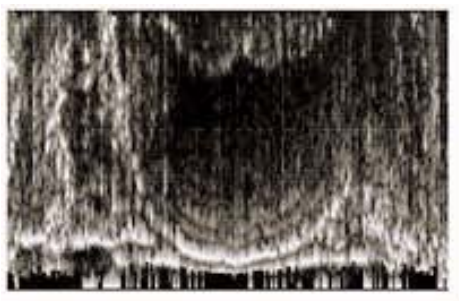


Figure 4

Testing of the device is a relatively simple process of conducting linear measurements using a "calibration standard" that was developed by the device manufacturer (Figure 5). The calibration standard consists of stainless steel rod whose length can be verified by an appropriate laboratory. The rod shown in Figure 5 has a nominal length of 100 mm. Initial calibration and subsequent testing is conducted by placing the standard on each transducer using a small amount of a gel substance to assure sonic transfer. The readings obtained should be equal to the length of the calibration standard.



Figure 5

The United States Department of Agriculture (USDA) performs tests of the device by placing the standard on each of the transducers 10 times and comparing the readings shown on the display with the calibrated values for the test block. This procedure verifies both accuracy and repeatability.

Similar, but more detailed test procedures for the AutoFom™, were approved May 1, 2006, and added to ASTM Standard-F2343-06. (See the ASTM website at www.astm.org, or contact ASTM Customer Service at service@astm.org for

referenced ASTM standards.) The device user is required to maintain a test standard with the device and is required to perform this procedure at the beginning of each production day. The standards maintained on site by the device user are required to meet the NIST Handbook 44, Appendix A Fundamental Considerations Section 3. Testing Apparatus. The user of the device is also required to have the accuracy of the test standard verified on an annual basis with traceability to a national standard. Weights and measures officials may elect to witness such testing on a periodic basis or may choose to conduct their own test using either their own standards or the standards maintained on site by the device user.

Subsequent articles in this series will provide information on other technologies

Split-draft Weighing

By Juana Williams

Since the 1930s the weights and measures community has raised questions about the practice of "split-draft weighing" a vehicle when the length of the vehicle exceeds the length of the scale platform. This article examines this practice and the related NIST Handbook 44 requirement that applies when determining the weight of a vehicle used in commercial applications.

The practice of split-draft weighing occurs when the front tractor or truck of the vehicle or vehicle combination (that is coupled or attached by connectors for the purpose of towing) are weighed, then the uncoupled trailer unit(s) or rear portion of the vehicle is weighed and the two weights are totaled for the vehicle weight (see the example in Figure 1 below). The practice is also referred to as "two-draft weighing," "two spotting," "double weighing," or "double-draft weighing."

Note that this practice is different from the acceptable practice of single-draft weighing in which the entire vehicle does not exceed the scale platform length (see Figure 2 on page 7)

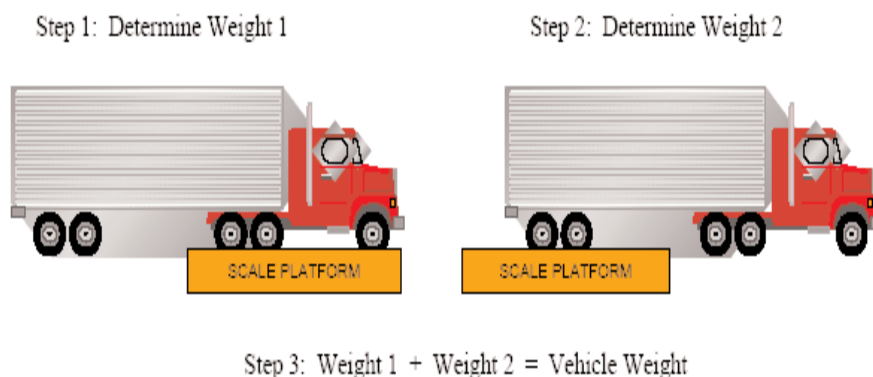


Figure 1: Split-draft Weighing

or the case of single-draft weighing on a scale with multiple platforms in which the length of each vehicle combination does not exceed the platform where it rests (see



Figure 2: Single-draft Weighing of a Vehicle (Figure 4 below).

In the 1930s rapid changes in the trucking industry resulted in new models of trucks with wheelbases longer than existing scale platforms. The practice of split-draft weighing began as a time-saving method (to eliminate the time spent uncoupling, moving, and recoupling the vehicle components, e.g., tractor and trailer) for determining truck weights on scales of insufficient length.

In 1938, in response to concerns about the appropriateness of split-draft weighing, NIST conducted a study that examined the errors associated with this practice. The study demonstrated that certain factors beyond the scale's performance contribute to the uncertainty in the weighing process:

- ♦ The grade and level of the approach below that of the scale result in a lower weight for a vehicle component.
- ♦ A vehicle or a vehicle combination of like design results in less external forces during each weighing.
- ♦ The nature and distribution of the load on the vehicle axles (e.g., liquids shift to a greater degree) affect the level of these external forces.
- ♦ The amount of shift in the load, which is more likely to occur the steeper the approach grade or with a quick stop on the platform, has an influence on the vehicle weight.
- ♦ The center of gravity for each vehicle unit as it relates to the shift of the load and type of commodity impacts the magnitude of these forces.
- ♦ Braking when pulling on the scale can cause the scale to bind resulting in a lighter weight.

- ♦ The proximity of the vehicle to the scale; the closer the vehicle is to the scale, the less external influence is on the vehicle's weight.

Given most transactions involve processes for determining both gross and tare weight (two weighings), when these external factors are introduced during both steps of the weighing process, the errors they contribute were found to total as high as 5.5 %. Additional studies were conducted in 1954 with similar results.

In 1955, the National Conference on Weights and Measures adopted an earlier version of current paragraph UR.3.3. Single-Draft Vehicle Weighing (a requirement that became effective in 1957) to address its concern about the practice of split draft weighing. This paragraph appears in the current edition of NIST Handbook 44 as follows:

UR.3.3. Single Draft Vehicle Weighing.

A vehicle or a coupled-vehicle combination shall be commercially weighed on a vehicle scale only as a single draft. That is, the total weight of such a vehicle or combination shall not be determined by adding together the results obtained by separately and not simultaneously weighing each end of such vehicle or individual elements of such coupled combination. However:

(a) the weight of a coupled combination may be determined by uncoupling the various elements (tractor, semitrailer, trailer), weighing each unit separately as a single draft, and adding together the results, or

(b) the weight of a vehicle or coupled vehicle combination may be determined by adding together the weights obtained while all individual elements are resting simultaneously on more than one scale platform.

Note: This paragraph does not apply to highway law enforcement scales and scales used for the collection of statistical data.
(Note Added 1992)

Paragraph UR.3.3. requires that only single-draft weighing be used for commercial vehicle weighing applications. That is, the entire vehicle must be weighed on a scale

of sufficient length. Commercial applications are those in which the weight indications are the basis for custody transfer, buying or selling, or determining transportation charges.

Paragraph UR.3.3. also specifies other acceptable methods for commercial weighing operations where the vehicle's wheelbase is longer than the scale platform. These methods are prescribed in sections (a) and (b) and illustrated in Figures 3 and 4, respectively. In section (a) the vehicle or vehicle combination can be uncoupled then weighed as single drafts. In section (b) the vehicle combination is weighed in single drafts on multiple weighing elements interfaced with a totalizing indicating element, where the weights are totalized. In either case the important point is that the vehicle or component should rest completely on a platform.

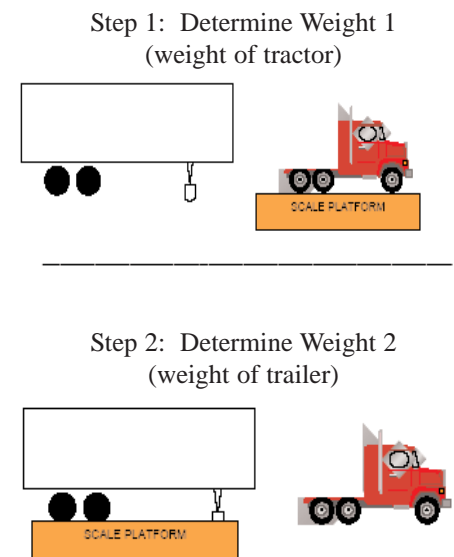


Figure 3: Single-draft Weighing of Uncoupled Vehicle Units (tractor and trailer).



Figure 4: Simultaneous Single-draft Weighing of Coupled Vehicle Units Resting on More Than One Scale Platform

In 1992, paragraph UR.3.3. was modified to include a note to clarify that the requirement (for only single-draft weighing of commercial vehicles) does not apply to

highway law enforcement scales and scales used to collect statistical data. While split-draft weighing is not ideal, the results prove to be accurate and practical enough to permit the practice in law enforcement and data collecting applications. Even though the sources for errors in split-draft weighing remain the same and deserve consideration, the weights and measures community has not changed its position to accept the practice as a necessary method of use in law enforcement and statistical weighing applications. Yet periodically over the past 60 years, the community has made changes to the Handbook because more stringent performance tolerances were warranted as improvements were made to scale technology used in these applications. The same limitation to only single-draft weighing does not apply to railway track scales.

It has been over 50 years since a formal study was conducted indicating that split-draft weighing is not appropriate; however, some suggest that it is time for a new study. While weighing technology continues to advance, no evidence has yet been presented to indicate that split-draft weighing consistently provides a sufficient level of accuracy for commercial vehicle weighing. In fact, some jurisdictions that have conducted informal studies on the practice continue to support the Handbook requirement for only single draft weighing of commercial vehicles.

If you have any questions about this information, please contact Juana Williams at 301-975-3989 or at juana.williams@nist.gov.

What do Grain Moisture Meters Measure and How are they Calibrated?

By G. Diane Lee

Did you know that grain moisture meters do not measure moisture? Most grain moisture meters measure an electrical property, such as capacitance, related to the dielectric constant of a test cell filled with grain. Although there are other types of grain moisture meters using different technologies to predict moisture, this article addresses grain moisture meters that make use of the dielectric constant of grain to predict moisture. What

is capacitance, what is a dielectric constant, and how do these relate to percent moisture? This article answers these questions, providing information on capacitance and dielectric constants, and how these measurements are used to determine the percent moisture of a grain sample and how they relate to the calibration of moisture meters.

What Grain Moisture Meters Measure

Water is a good insulator. Insulators have tightly bound electrons and can store electrical charges. A dielectric or electrical insulator is a material that is highly resistant to the flow of electrical current. Capacitance is a measure of the amount of electric charge stored (or separated) for a given electric potential. Capacitance exists between two conductors insulated from one another. A dielectric constant can be determined by measuring the capacitance of a capacitor (two conductors or plates) with air between the plates, then measuring the capacitance with a dielectric material between the plates. The ratio of these measurements is used to determine the dielectric constant.

The dielectric (capacitance) technology used in many grain moisture meters is based on the principle that a functional relationship exists between the moisture content of grain and its dielectric constant. As grain increases in moisture content (water), its dielectric constant increases. The rate at which the dielectric constant increases as grain moisture increases is not the same for all grain types; therefore, a unique calibration equation must be developed for each grain type to be measured. Moisture meters based on the dielectric principle typically incorporate a test cell in the form of an electrical capacitor, that is, two conductors separated by an insulator. When the cell is empty, only air separates the two conductors, and the insulator is air.

When a grain sample to be measured is placed between the conducting surfaces of the test cell, the grain displaces most of the air. By sensing the change in the electrical characteristics of the capacitor due to the dielectric properties of the grain sample, the meter can predict the moisture content of the sample. Because the bulk density and the temperature of the grain sample

also affect the electrical characteristics of the grain-filled test cell, the meter must measure these parameters and apply the necessary corrections.

Some instruments using this method also have the capability to correct for surface moisture (conductance) effects. Year-to-year and regional changes in growing conditions and genotype variations within a single grain type can also result in changes in the relationship between dielectric constant and moisture. These changes are effectively 'averaged out' by developing calibrations using three or more years of data representing all geographic areas.

Grain Moisture Meter Calibrations

As noted above, dielectric grain meter technology requires the use of unique calibration equations for different grains. Because meters measure the effect of moisture on certain electrical properties of grain, and because a functional relationship exists between moisture and these measured properties, a calibration equation or table can be developed that assigns a unique moisture value (air-oven reference method* moisture value) for each set of measured parameters.

To develop meter calibrations, grain samples are collected from a wide variety of moisture ranges, varieties, geographical diversities, and several crop years. Data are collected for oven moisture values, capacitance (or a related parameter), sample weight (per test-cell volume), and sample temperature. The data are evaluated and adjusted to remove outliers and to make baseline and other corrections; the data are then fitted to a calibration curve. (See Figure 1, Typical Calibration Data). Thus, measurement results obtained with a grain meter are only as good as the meter calibration. Since the calibrations are based on the data collected from a sample set of grain, if the sample grain used to test the meter is atypical (an outlier) or if a grain sample used to test the meter is not represented in the calibration sample set, the instrument may not provide accurate results on these samples when in use.

** The air-oven reference method is used to determine the reference moisture of grains.*

The air-oven reference method involves weighing a grain sample prior to and after a designated amount of heat is applied to the sample of grain over a specified amount of time. The grain sample is prepared (ground or air dried) prior to the oven test. Percent moisture is calculated base on the amount of weight loss in the grain sample.

Every year States are requested to participate in providing samples to the USDA, GIPSA for the national sample set that is used to develop calibrations for NTEP grain moisture meters. The more representative the sample set used to establish the calibrations the more representative the calibrations will be. The NIST Weights and Measures Division continues to encourage States to annually submit grain samples for the national sample set.

Future articles will follow that discuss other technologies used in determining grain moisture. Contact Diane Lee of the NIST Weights and Measures Division by phone at 301-975-4405 or by e-mail at diane.lee@nist.gov for additional information concerning grain moisture measurements.

Electronic Cash Registers (ECR) and Point-of-Sale Systems (POS) Interfaced with Scales.

Part 1 - Background

By Steve Cook

This article is the first part of a two-part article intended to provide weights and measures officials background information on the reason electronic cash registers (ECR) and point-of-sale (POS) systems interfaced with scales are regulated by weights and measures.

For those of you who may not remember black and white televisions or vinyl records, at one time the supermarket industry used mechanical price computing scales at customer checkout stands to determine the money value of items sold from bulk. The weight and price for the items were determined on the scale. The price of the weighed items were then manually entered into the cash register where

Normalized
parameter
related to the
dielectric
constant

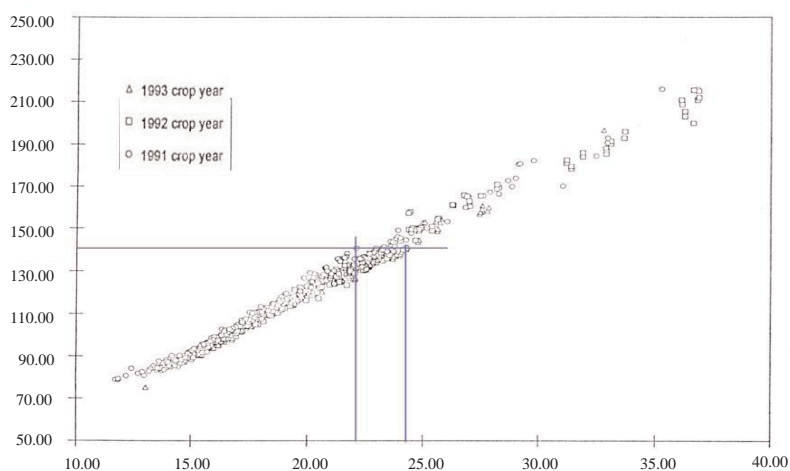


Figure 1. Typical Calibration Data (diagram courtesy of John W. Barber, Grain Moisture Meters from Theory to Practice)

the prices of all weighed and non-weighed items were totalized and summed on the cash register receipt. Therefore, weights and measures officials only examined the price computing scales and not the cash registers since weights and total prices of items were determined at the scales. Some of the problems associated with using mechanical price computing scales included lack of a tare capability in many scales, limited price computing capabilities and readability problems such as parallax, burned out lights on optical indicating scales, and selecting a computed price graduation in a series of graduations that came closest to the index wire for the weight graduation.

The introduction of ECRs interfaced with electronic scales (also known as automated checkout stands) occurred in the late 1960s and early 1970s and provided many advantages over mechanical price computing scales and cash registers for both the supermarket and the customer. These systems had greater price computing and tare capabilities. Additionally, weights determined on electronic or electromechanical scales were electronically transmitted to the ECR where the total price was automatically calculated by entering a unit price from the ECR product look-up (PLU) memory or manually entered product codes, and receipts from ECRs had the capability of providing customers with more information than receipts from mechanical cash registers. Manual entries of total price were no longer required thus increasing cashier

efficiency and decreasing the number of keyboard errors by the cashier.

During the 58th Annual Meeting of the National Conference on Weights and Measures (NCWM) in 1973, weights and measures officials studied these new systems and held discussions with ECR and scale manufacturers. The NCWM agreed that ECRs interfaced with scales were subject to the applicable requirements in NIST Handbook 44 since they had a metrological impact on the accuracy of net weight and total price of commercial transactions and were separable components of a weighing system. The Specifications & Tolerances Committee of the NCWM developed a list of several requirements in Handbook 44 that are applicable to these systems including: tare capability; zero indication when the scale was in a zero-balance condition that is visible to the customer and operator; printing of net weight; unit prices; and total prices; indicated and printed values be adequately defined; position of equipment so that scale indications were in clear view of the customer; and price calculations of weighed items rounding to the nearest 1-cent.

The definition for "point-of-sale system" was added to Handbook 44 Appendix D in 1986 to clarify the terminology already used in Handbook 44. A POS system is currently defined as an "assembly of elements including a weighing or measuring element, an indicating element, and a recording element (and may also be

equipped with a "scanner") used to complete a direct sales transaction." The POS system typically includes a scale, an ECR, additional computers, customer displays, video monitors, and controllers. The POS ECR is designed to read the gross weight output of a small-capacity scale which is commonly called a "point-of-sale scale." The POS scale may have a built-in or pedestal-mounted display of the gross weight. The POS ECR takes the weight information from the scale and:

- determines that the weight is stable and valid, is not below zero, and does not exceed the scale capacity;
- calculates the net weight using a tare value from either a preprogrammed or manual entry;
- multiplies the net weight by a unit price, either entered manually or entered through a product database via product look-up codes or by using the UPC (Universal Product Code) scanner;
- rounds the results of the unit price times the net weight to the nearest cent; and
- prints the net weight and other information required in Scales Code paragraph S.1.8.4. Recorded Information, Point of Sale Systems on a customer receipt.

It should be noted that the definition of "point-of-sale systems" does not apply to some ECRs interfaced with retail price computing scales since direct sale transactions can be completed without the use of the ECR, provided the ECR does not metrologically impact the accuracy of the weighing and pricing transactions. NTEP established evaluation criteria for POS systems in the early 1980s and listed the conditions under which ECRs are not considered "point-of-sale systems." These conditions are outlined in the 2006 edition of NCWM Publication 14 and will be discussed in Part 2 of this article in this newsletter titled "Examination of Electronic Cash Registers (ECR) and Point-of-Sale Systems (POS) Interfaced with Scales."

Up to this point, this article has discussed several of the events related to POS systems that took place in the 1970s and 1980s. The marketplace continues to utilize improvements in computer technology and introduce new marketing practices. Some of the more recent developments in POS systems include:

- Scanners incorporated into the POS scale. These devices are also commonly referred to as scanner/scales and are evaluated by NTEP to verify that the scanner has no metrological impact on weight determinations and related functions. POS scales with a built-in scanner feature will have the scanner feature listed on the National Type Evaluation Program (NTEP) Certificate of Conformance (CC).

- Cash-acceptors and card readers. These devices may be used with POS systems to authorize or initiate sales to the customer and are also known as "self-service POS systems." These systems are nearly identical to cashier operated systems except the system prompts the customer through the checkout process using visible (and sometimes audible) instructions and graphics on an interactive customer operated display. These systems are frequently attended by cashiers who oversee the operation of several checkout lanes and are available to assist customers if necessary. NTEP evaluates these systems to verify the following in order for the self-checkout feature to be listed on an NTEP CC:

- The zero-balance condition of the POS scale and the net weight of the object are provided to the customer.
- The amount billed against bank or credit cards is printed on the customer receipt.
- The amount of cash tendered is displayed and printed on the customer receipt, and the denominations of the cash tendered are documented with a journal or other printer.
- Correct change with the amount of change is displayed and printed on the customer receipt.
- The customer can discontinue or cancel the checkout process without tendering cash or having the transaction billed against the debit/credit card.
- The customer can retrieve cash tendered in the event of a malfunction or power failure.
- The clear instructions (e.g., "see attendant for . . .") in the event there is insufficient paper to print a receipt or insufficient change.

- Card readers. These devices may be used with POS systems that do not authorize or initiate sales to the customer. These devices have no metrological effect on weight or money determinations. They may also be used to enter loyalty card member information that, among other

things, instructs the POS system to apply member discounts to the transaction. These devices are not evaluated by NTEP and are not regulated by weights and measures officials.

- Customer loyalty programs/member discount programs. These types of programs offer its "members" discounts applicable to items in the stores. To receive the discount(s), a customer must present a loyalty or membership card or provide other means of member identification before the total sales transaction is completed. Because of the potential for inaccurate calculations and fraud, NTEP reviews the discount feature against the minimum requirements during type evaluation by verifying that the discount program: 1) is not capable of altering net weights, 2) rounds all price calculations involving weighed items to the nearest one cent, and 3) clearly prints the original unit price and total price of the weighed item on the customer receipt (or on the label of prepackaged random weight items). The inspector should be aware that NTEP is unable to anticipate all possible discount programs and scenarios and cannot guarantee the software used in these discount programs will not be altered; therefore, the three requirements listed above should be verified during initial and subsequent inspections.

- Not-built-for-purpose, software-based POS systems. In addition to the type evaluation requirements in NCWM Publication 14, NTEP evaluates the marking requirements unique to these devices (e.g., on-line display of required information).

- Screen saver or advertising modes. These modes of operation replace the primary weight indications (and other information) on ECR customer displays during a period of non-activity. NTEP evaluates these features to verify the POS system inhibits the weighing operation or returns to a continuous indication when the POS scale is in an out-of-balance condition according to Scales Code paragraph S.1.1. (c). Zero Indication.

As you can see, the same Handbook 44 requirements for POS systems that were first considered by the 58th NCWM in 1973 discussed earlier in this article are still valid considering the recent advancements in technology and new marketing practices. That is, the ECR is a metrologi-

cally significant part of the weighing system and customers are given the information and documentation necessary to make informed decisions regarding the validity of weighing transactions over the POS system.

For information and guidelines that can be used to inspect these systems, please see the accompanying article "Examination of Electronic Cash Registers (ECR) and Point-of-Sale Systems (POS) Interfaced with Scales" in this newsletter.

Electronic Cash Registers (ECR) and Point-of-Sale Systems (POS) Interfaced with Scales.

Part 2 - Examination

By Steve Cook

This is the second part of a two-part article on Electronic Cash Registers (ECR) and Point-of-Sale Systems (POS) Interfaced with Scales and is intended to provide weights and measures officials with guidelines and test procedures that can be used to examine electronic cash registers (ECR) and point-of-sale systems (POS) interfaced with scales. If you have read Part 1, you are aware of the reasons that POS systems interfaced with scales are regulated by weights and measures.

WMD has reviewed the examination procedure outline (EPO) for ECRs developed by the California Division of Measurement Standards, applicable National Type Evaluation Program (NTEP) test procedures in 2006 edition of the National Conference on Weights and Measures (NCWM) Publication 14, and applicable requirements in NIST Handbook 44 in order to develop these additional examination guidelines that can be used in conjunction with NIST Handbook 112 EPO for Retail Computing Scales.

Inspection: Upon entering the establishment, the inspector will notify a manager or supervisor, just as he would when inspecting any other weighing or measuring device. However, the inspector should ask that the system under test be placed in a "training mode," "VOID mode," or some other mode of operation where cash drawers will not open and totals affecting the

store's inventory of money and products will not be accumulated. Many inspectors will request that the store managers provide assistance in the operation of the POS system (and remove cash drawer, if necessary), citing Handbook 44 General Code paragraph G-UR.4.4. Assistance in Testing Operations.

As discussed in Part 1 of this article, the definition of "point-of-sale systems" does not apply to some ECRs designed to accept only the total price of a weighing transaction from a computing scale. This scenario essentially makes the ECR a price accumulator and printer. NTEP established evaluation criteria in the early 1980s listing the conditions where an ECR interfaced with a computing scale is not considered a "point-of-sale system," provided the ECR does not metrologically impact the accuracy of the weighing and pricing transaction. The current conditions are listed in the 2006 edition of NCWM Publication 14 as follows:

- The computing scale displays the weight, unit price, and total price on both the customer and operator side of the scale.
- The computing scale has a functioning tare capability.
- The computing scale is positioned so the customer can accurately read the indications and observe the weighing operation.
- The computing scale is equipped with motion detection that complies with Handbook 44 paragraph S.2.5.1. Digital Indicating Elements.
- The computing scale is not equipped with price look-up or scanner capability. Unit prices must be entered manually at the computing scale to give the customer adequate time to view the information and make an informed decision on the acceptance of the transaction.
- The computing scale shall not have an operational sales accumulation feature or shall have that feature disabled since the ECR accumulates sales of all items.
- The ECR cannot have any input to the computing scale in determining the total of a weighed transaction.

These seven items are evaluated by NTEP in order for the "ECR interface" feature to be listed on the NTEP CC for the computing scale and the "computing scale interface" feature to be listed on the NTEP CC for the ECR.

1. General considerations: For jurisdictions requiring NTEP Certificates of Conformance (CCs), the inspector should review the ECR and POS scale CCs and determine that the manufacturer has designated them for the service selected by the user and verify that the features and options, locations of identification and sealing mechanism, and special operations or limitations are consistent with the information contained in the CC.

2. Markings: Verify that the required markings are provided for the POS system and separable components. These include General Code identification requirements, operational controls, identification of indications, accuracy class, capacity, value of the scale division, and maximum number of divisions for separable indicating and load-receiving elements. The NTEP CCs for the POS system and POS scale will provide information on the content and location of the required markings. The official should be aware that POS scales may not always provide the primary weight indications in the system. In order for the POS system to comply with the requirements for a primary weight indication in General Code paragraph G-S.5.1.1. General, the primary weight display will be provided by the ECR or other parts of the POS system. As discussed above, information on the location of the required markings will be contained in the CC. Additionally, separable devices that have no metrological impact on the accuracy of the transaction, such as cash drawers, card readers, and scanners, are not required to be marked by Handbook 44.

Many POS systems are type evaluated as "not-built-for-purpose," software-based devices." Unless the POS software identification information is continuously displayed on the screen or physically marked on the device, it may be difficult to determine the manufacturer and model designation of the software used in the system. General Code paragraph G-S.1.1.1. Location of Marking Information for Not-Built-For-Purpose, Software-Based Devices allows these devices to have:

- All required identification information or just the CC number* physically marked or continuously displayed on the device, or

- All required identification information or just the CC number* easily recalled from memory through easily accessible "view only" system identification where the information can be accessed through a clearly marked key, a computer type menu item, or listed in the help menu. This would be equivalent to verifying the software identification of other types of software programs in the "about" screen in the "help" menu on computers.

* Note: If the CC number alone is provided, the CC must include instructions for accessing the remaining identification information listed in the "Identification" paragraph of the applicable CC.

3. Indicating and recording elements.

All requirements in General Code paragraph G-S.5. Indicating and Recording Elements are applicable to a POS system if the device provides the primary weight indications. Additional paragraphs to carefully consider are: General Code paragraph G UR.3.3. Position of Equipment and Scales Code paragraphs S.1.1. Zero Indication, S.1.1.1. Digital Indicating Elements, and UR.4.1. Balance Condition.

Weight indication and zero-balance information must be visible at all times from a normal customer's and operator's position. When ECRs are interfaced to POS scales, the customer must be provided with a "live" continuous zero balance or weight information visible at all times from a normal customer position. This can be accomplished in one of the following ways:

- The ECR may have an integral weight indicator that is part of the terminal. However, the "live" continuous weight indication must be entirely separate from the price transaction portion of the customer display.
- The ECR may have a remote customer's weight indicator mounted on or adjacent to the terminal or the POS scale.
- The POS scale may have a built-in customer's weight indicator or have a remote customer's weight indicator mounted on or adjacent to the terminal or weighing element.

4. Checking the zero-balance condition.

The zero-balance condition of the POS scale must be available to both the customer and the operator. As mentioned ear-

lier, POS scales may not always provide the "live" continuous primary weight indications in the system. In these cases the only primary "live" continuous weight indication is located at the ECR display of the POS system. In many supermarkets, the ECR display may go into a "screen saver" or display a scrolling message if the POS system has not been in use for a period of time. This can be an indication that the scale is in a zero-balance condition if the cashier is not required to enter a log-in number, code, or take other action to turn off the "screen saver" mode and check the zero-balance condition of the scale.

If the screen saver or scrolling messages are intended to represent the zero condition of the scale, the primary weight indication of the POS system shall be identified with zero annunciators, or words such as "scale ready," "zero," or markings or indications that state that the "screen saver" or "scrolling message" means the scale is in a zero-balance condition. To verify this feature is operating correctly, add an object to the scale while it is in the "screen saver" mode. The scale shall display either an error condition or a weight value. If the scale displays a weight rather than an error condition, remove the weight from the scale and verify that the weight indication returns to zero.

Pretest Determinations: See Handbook 112, EPO No.1 for Retail Computing Scales for additional determinations applicable to the POS system.

Test and Test Notes: The following should be considered and verified during the examination of POS systems in addition to the test notes and tests listed in Handbook 112, EPO No.1 for Retail Computing Scales.

1. Increasing-load, decreasing-load, shift, discrimination and zero-load balance change tests. - These tests are applicable to the POS scale and are the same tests that would be applied to electronic price computing scales in NIST Handbook 112, EPO No.1. During these tests, you may want to enter a unit price at various test loads to verify motion detection capability, price calculations, or document the test results.

2. Motion detection. - Depending upon the manufacturer, the POS system will usually print the weight indication when the "scale," "weight," or department key is pressed or PLU number is entered. Scales Code paragraph S.2.5.1. requires that the scale complies with motion detection requirements and all POS scales have been type evaluated with that capability. Tests for motion detection requirements are still required on the POS system since it should only capture stable weights sent from the POS scale.

3. Test for over-capacity indication. - Both the POS system and its associated POS scale shall not indicate or record values exceeding 105 % nominal capacity according to Scales Code paragraph S.1.7. Capacity Indication, Weight Ranges, and Unit Weights. Place a test load on the POS scale exceeding 105 % of the nominal capacity of the scale (for example, 105 % is 31.50 lb on a 30-lb capacity scale) and attempt to enter a PLU number of an item sold by weight. There should be no indication of weight on the primary weight display or the customer receipt, and the ECR should provide a visible or audible error condition.

4. Price look-up. - Verify accuracy and correctness of transactions based on product look-up and scanner entries. You may want to look at a current newspaper advertisement for that information, or prior to starting POS system testing, take a walk through the produce and bulk food sections of the store noting the price on various items. Then using the product code listing (usually adjacent to the ECR), enter or have the cashier enter the PLU's for those chosen scale items into the register with a 1 lb weight on the scale.

The inspector should also select items that are sold by multiple pound or multiple items per unit price (e.g., 3 lb for \$1.00 or 7 items for \$1.00). This is commonly known as split-pricing. You will recall that the price items sold by weight shall be rounded to the nearest 1-cent money value. An example of verifying the correct rounding will be included in the subsequent test for mathematical calculations. Non-weighted split-priced items may be calculated based on normal marketing practices

unless otherwise posted. Using the example of 3 items for \$1.00, the price of non-weight split-priced items may be recorded as \$0.34, \$0.34, and \$0.33 unless otherwise posted. For example, if the customer purchases only a single item, he may be charged the regular price for that item. Other pricing structures, such as "buy 2 at the regular price and get the 3rd one free," may be acceptable if the information is posted and correctly calculated.

5. Tare capability. - Verify operation and accuracy of these systems. The tare mechanism must have sufficient capacity to equal the heaviest tare container used. Tare capability may be achieved in one of the following methods according to Scales Code paragraph S.2.3, Tare: pre-programmed "global tare," or tare programmed as part of the product information in a PLU, or a manually entered keyboard tare. A single tare value (sometimes called a "global tare") may be programmed into the register if a single tare value is adequate for all tare material (bag, twist ties, labels, etc.). Provision to override tare is acceptable if the standard tare is not to be used for a particular transaction. For example, the tare value for coffee sold from bulk may be heavier than the global tare and there may be different tare values for different sized containers at salad bars. Tare values programmed into the PLU codes can override the global tare.

- Tare programmed with the price look-up information. - Check items from bulk items in the store that are in a bag or tray that would require a tare to be taken (such as produce, bulk coffee, bulk candy, bulk health food items, soup and salad bar - if sold by weight). Verify that the correct tare is applied by observing the net weight value on the printed receipt and the displayed gross weight. Remember to include any ties, labels or other tare materials used with the bag or container.

EXAMPLE: Entering the PLU for fresh mushrooms, place a 1 lb test weight on the scale and print a receipt. If the tare for a plastic bag and tie is 0.01 lb, you should see a printed net of 0.99 lb. If the PLU is for freshly ground coffee, you may see a different net weight, of say 0.94 lb, since coffee is typically weighed in a heavier paper bag. In all cases, check the tare against the type of bag or tare material used.

- Keyboard tare. - This tare normally functions when the operator enters a number prior to pressing the scale key.

EXAMPLE: With 1.00 lb placed on the scale, the operator enters "2" before activating the "scale" key and the ECR prints 0.98 lb net weight on the customer receipt. Thus the "2" corresponds to a tare of 0.02 lb.

6. Mathematical agreement. - Handbook 44 paragraph G-S.5.5. Money Values, Mathematical agreements requires that any money-value shall be in mathematical agreement with its associated quantity representation to the nearest one cent of the money value. The correct computation of money values for both manually entered and price look-up unit prices can be verified by using the following table:

Net Weight (lb) *	Unit Price (\$/lb)	Total Price	Correctly Rounded
0.10 lb	\$0.15	\$0.0150	\$0.01 or \$0.02
0.32 lb	\$0.83	\$0.2656	\$0.27
0.32 lb	\$0.89	\$0.2848	\$0.28
2.54 lb	\$0.79	\$2.0066	\$2.01
2.54 lb	\$0.86	\$2.1844	\$2.18
20.67 lb	\$0.59	\$12.1953	\$12.20
2.00 lb	3 lb/\$1.00	\$0.3333	\$0.33
2.00 lb	3 lb/\$1.00	\$0.6667	\$0.67
3.00 lb	3 lb/\$1.00	\$1.0000	\$1.00

*Additional weights may need to be added to or removed from the POS scale in order to reach the desired net weight.

The weights and measures official must also be aware of special marketing programs (also known by terms such as "frequent shopper," "member discounts," etc.) that offer products at a discount where the discount is taken at the POS system. Because of the potential to facilitate fraud, the net weight shall not be altered and shall be printed on the receipt. Among other things, all calculations shall be rounded to the nearest cent, and the original unit price and total price must be printed on the customer receipt or on the label of a prepackaged random weight object. NTEP reviews these features during type evaluation, but changes are frequently made to these marketing programs and the official must verify that the minimum information is available to the customer during initial and subsequent examinations. The following is an example of a member discount receipt.

Posted Price

TOMATOES Member Price \$1.89/lb
Non-Member Price \$2.29/lb

Customer Receipt

Good Foods		
100 Bureau Drive		
Gaithersburg, MD 20899		
2.46 lb	@2.29/lb	5.63
Tomatoes		
2.46 lb	@1.89/lb	Member Price
		4.65
Tomatoes	Member savings	\$0.98
Tax 6 %		.28
TOTAL		\$4.93

7. Manual weight entries. - Scales Code paragraphs S.1.12. Manual Weight Entries and UR. 3.9. Use of Manual Weight Entries permit the use of manually entered gross and net weights only under the following conditions when:

- A POS system is giving credit for a weighed item,
- An item is pre-weighed on a legal-for-trade scale and marked with the correct net weight,

- The gross or net weight indication is at zero, and
- The words "Manual Weight," "Manual Wt.," or "MAN WT" must be automatically printed on the customer receipt.

8. Review of the customer receipt. - Scales Code paragraph S.1.8.4. Recorded Representations, Point-of-Sale Systems requires that the receipt contain the net weight of the object, its associated unit price, the total price for that object, and the name of the product, product code, or product class (e.g., produce, meats, etc.). Paragraph G-S.5.1. General (Indicating and Recording Elements) states that all indications and recorded representations shall be clear, definite, accurate, and easily read under any conditions of normal operation of the POS system. The receipt typically will have a minimum of three columns for the net weight, unit price, and total price. The columns shall be sufficiently separated from each other to facilitate understanding by the customer. The net weight information also needs to be identified with the appropriate weight units (e.g., lb or kg). The required information may also be on separate, but consecutive lines so that the receipt can be easily read from left to right and top to bottom. NTEP reviews the POS customer receipts during type evaluation, but changes are frequently made to the format and content of the customer receipt by the store and the official must verify that the minimum information is available to the customer and in a format that is understood by the customer during initial and subsequent examinations.

9. Subsequent Examinations. During subsequent examinations of POS systems, the inspector needs to perform the performance tests outlined in steps 1 thru 3, and verify correct tare values are still being used since tare materials may have changed from the previous inspection and the features evaluated during the initial examination must continue to comply with Handbook 44.

The above examination guidelines will form the basis for a complete EPO or an addendum to the EPO retail price computing scales, which will be further developed and included in NIST Handbook 112. Please contact Steve Cook at

owm@nist.gov with comments and suggestions for the final EPO. Electronic copies of these guidelines will be posted on the WMD Internet homepage (www.nist.gov/owm) and can be accessed by selecting the link to the "Weights and Measures Quarterly Newsletter Archive" in the column titled "W&M Resources" or by using the following URL: <http://ts.nist.gov/ts/htdocs/230/235/newsletterarchive.htm>.

Metrology News & Updates

State Metrology Laboratory: Training Event of the Year!

Reminder: the upcoming Combined Regional Measurement Assurance Training (CRMAP) will be held October 29 to November 3 in Broomfield, CO. Please see the NIST website for agenda and detailed session descriptions at <http://www.nist.gov/lab-metrology>.

This training is required for ongoing-WMD laboratory recognition (per NIST Handbook 143, p. 32 and Table 2, p. 48.) The results of proficiency tests (round robins) will be presented and reviewed at the meeting, along with numerous special technical sessions that are not normally covered in other NIST seminars or at the regional meetings.

Registration:

Pre-Paid: Check-in will be held on October 29, 2006, from 10:00 a.m. until 12:00 N at the Omni Hotel, lobby area.

On-site: Check-in will be held on October 29, 2006, from 12:00 N until 1:00 p.m. at the Omni Hotel, lobby area.

Instructor registration: badge pick-up with pre-paid registrations.

Course registration fee: \$425 (industry); \$225 (state government officials). Fee includes Training Resources & Instruction, Sunday Reception, and Thursday Dinner, (but does not include hotel or other meals).

Requests for cancellation and refund must be received in writing by October 16, 2006.

REGISTRATION DEADLINE: October 25, 2006. Late registrations must be handled during on-site registration.

General conference inquiries:

Wendy McBride, Conference Program Manager

NIST, Directors Office, 325 Broadway, Div. 104

Boulder, CO 80305

Phone: 303-497-4500, Fax: 303-497-5208
wmcbride@boulder.nist.gov

Accommodations: A limited number of rooms are being held at the hotel listed below. Reservations should be made early to ensure the group rate. Requests received after September 21, 2006, will be filled on a space-available basis. For hotel reservations, please contact:

Omni Interlocken Resort
500 Interlocken Boulevard
Broomfield, CO 80021
303-438-6600
1-800-400-1700

Rates: \$108 (single or double) + 9.85% tax (Rates subject to change based on prevailing government per diem at the time of conference.) Group rates are available 3 days prior and 3 days after the meeting dates.

See hotel features here:

<http://www.omnihotels.com/FindAHotel/DenverInterlocken.aspx>

OIML Activities & Updates

Update on Some Key OIML Activities

The Weights and Measures Division (WMD) of the National Institute of Standards and Technology (NIST) is responsible for coordinating U.S. participation in the International Organization of Legal Metrology (OIML) and other international legal metrology organizations. Throughout the report, acronyms are used. Following is a key to some of those acronyms:

TC – Technical Committee
SC – Subcommittee

CD – Committee Draft
WD – Working Draft
DR – Draft Recommendation
R – Recommendation
USNWG – U.S. National Work Group
CIML – International Committee of Legal Metrology

Learn more about OIML at the OIML website at <http://www.oiml.org> and the NIST website at <http://www.nist.gov/owm> on the Internet. Dr. Charles Ehrlich, Group Leader, can be contacted at charles.ehrlich@nist.gov or at 301-975-4834.

I. Technical Subcommittees

TC5/SC2 Software

All OIML Documents and Recommendations published since 1990 have been reviewed for terms and requirements related to software. The first working draft of the document “Software in Legal Metrology” was circulated in February 2006 by the Secretariat. This draft was discussed during an April 2006 National Type Evaluation Software Sector Meeting held in Annapolis, MD. U.S. comments were returned to the Secretariat in June 2006. When complete, this document will serve as guidance for OIML technical committees addressing software requirements in OIML Recommendations for software-controlled instruments. Please contact Wayne Stiefel at 301-975-4011 or at stiefel@nist.gov if you would like to participate in this project.

TC7SC4 “Measuring Instruments for Road Traffic”

The United States sent a “yes” vote and comments on the 4th CD of R21 “Taximeters” in May 2006. This is an OIML high priority project, and the document includes the latest in taximeter technology which will be useful in the next revision of NIST Handbook 44. Please contact Juana Williams at 301-975-3989 or juana.williams@nist.gov for a copy of this document or to participate in this project.

TC8/SC1 “Static Volume and Mass Measurement”

The Secretariat submitted 2nd CD revisions in January 2006 for OIML R71 “Fixed Storage Tanks,” R80 “Road and

Rail Tankers,” and R85 “Automatic Level Gages for Measuring the Level of Liquid in Fixed Storage Tanks.” The United States provided extensive comments on all of these documents, which were discussed at TC8/SC1 meeting in Hamburg, Germany, in April 2006. Please contact Wayne Stiefel at 301-975-4011 or at stiefel@nist.gov if you would like copies of the documents or to participate in these projects.

TC8/SC3 + SC4 Measuring Instruments for Liquids other than Water

OIML R117 “Measuring Instruments for Liquids other than Water” is undergoing an extensive revision that incorporates new instrument technologies and merges the document with two other OIML recommendations. The U.S. National Work Group on flowmeters is working closely with Germany, the Netherlands, and Canada on this effort. A 2nd CD of R117 received over 90 % international “yes” votes. The DR of R117-1 (General and Technical Requirements) will be circulated to OIML member nations for vote and approval late 2006. If you have questions or would like to become involved in this effort, please contact Ralph Richter by email at ralph.richter@nist.gov or at 301-975-4025.

TC8/SC7 and SC8 Gas Metering

Comments were returned to the Secretariat in November 2005 on the 4th CD “Measuring Systems for Gaseous Fuel.” This Recommendation is intended for large pipelines with large flowrates and high operating pressures. OIML R6 “General provisions for gas volume meters,” R31 “Diaphragm Gas Meters,” and R32 “Rotary Piston Gas Meters and Turbine Gas Meters” have been revised and combined into a single Recommendation. The Secretariat circulated a 3rd CD of this document, and U.S. comments were returned in January 2006. The final draft of this recommendation should be approved by the CIML in October 2006. Please contact Wayne Stiefel at 301-975-4011 or at stiefel@nist.gov if you would like to participate in these projects.

TC9 “Instruments for Measuring Mass”

The United States will begin the review

cycle for R60 “Load Cells” after the revision of R76 “Non-automatic Weighing Instruments” is complete, probably late in 2006. If you would like to participate in the revision of R60, please contact Steve Cook at 301-975-4003 or steven.cook@nist.gov.

TC9/SC1 “Nonautomatic Weighing Instruments”

The United States voted “yes” on the 3rd CD of R76 “Non-automatic Weighing Instruments” in June 2006 and expects the DR to be approved by the CIML in October 2006. The revision includes new language addressing metrological controls for type evaluations, conformity, and initial and subsequent inspections. The USNWG is being consulted concerning proposals to further harmonize NIST Handbook 44 and R76. If you would like to participate in this effort, please contact Steve Cook at 301-975-4003 or steven.cook@nist.gov.

TC9/SC2 “Automatic Weighing Instruments

Two documents in this subcommittee are now being revised. The United States has returned comments on a WD of R106 “Automatic Rail-weighbridges” and a 1CD of R107 “Discontinuous Totalizing Automatic Weighing Instruments (Totalizing Hopper Weighers).” If you would like to receive copies of any of these documents or work on these projects, please contact Richard Harshman at 301-975-8107 or at harshman@nist.gov.

TC17/SC1 “Humidity”

The Secretariat (China) is working closely with the United States and a small international work group (IWG) to revise OIML R59 “Moisture Meters for Cereal Grains and Oilseeds.” Please contact Diane Lee at 301-975-4405 or at diane.lee@nist.gov if you would like to participate in this work group.

II. Mutual Acceptance Arrangement (MAA) on OIML Type Evaluations

The OIML MAA is now being implemented. The first Committee on Participation Review (CPR) has been established for OIML R60 (Load Cells) and R76 (Non-automatic Weighing Instruments). The CPR is being called ‘provisional’ to reflect the fact that the participants are under no

obligation to sign the Declarations of Mutual Confidence (DoMCs) for the two instrument classes.

The first meeting of the CPR was held in June 2005, in Lyon, France, in conjunction with the 40th CIML Meeting. Twenty-one countries had representatives at the meeting, and the committee reviewed the application files of the nine countries wishing to be Issuing Participants. (An 'Issuing Participant' is one that performs tests and issues certificates under the DoMC.) A draft implementation document on using ISO/IEC 17025 (requirements for testing laboratories), to be used for conducting the legal metrology audits, was also discussed. Another implementation document on ISO Guide 65 (requirements for issuing authorities) was circulated to the CPR for comment after the meeting. These implementation documents have been distributed as Working Drafts, for comment, to OIML TC3/SC5, to be developed as OIML Documents.

A seminar (training course) for peer review assessors was held in September 2005 in Paris.

After the second CPR meeting was held in March 2006 in Sydney, Australia, the signing of the DoMCs for R60 and R76 started. The National Conference on Weights and Measures (NCWM) signed the DoMC (as a 'Utilizing Participant') for R60 during a ceremony at the NCWM Annual Meeting in Chicago in July 2006. Under this DoMC, the National Type Evaluation Program (NTEP), run by NCWM, will accept test data on load cells that are tested according to the requirements in OIML R60 (and 'additional,' agreed-upon requirements), from 'Issuing Participants' under the DoMC, to use as the basis of issuing NTEP Certificates of Conformance.

OIML TC3/SC5 will start revising both publication B101 (MAA) and publication B3 "OIML Certificate System for Measuring Instruments" after some additional experience with the MAA has been gained. Further implementation of the MAA may require other detailed regulations be developed.

For further information on the MAA and its implementation, please contact Dr. Charles Ehrlich at charles.ehrlich@nist.gov or at 301-975-4834 or by fax at 301-926-0647.

Upcoming OIML Meetings

The 41st CIML Meeting will be hosted by South Africa in Capetown in October 2006. The People's Republic of China will likely host the 42nd CIML Meeting in China in October 2007.



Calendar of Events

2006

SEPTEMBER

10 – 14

Western Weights & Measures Association (WWMA) Annual Meeting
Radisson Downtown
Salt Lake City, Utah
Contact: Brett Gurney, 801-538-7158 or bgurney@utah.gov

17 – 19

Central Weights & Measures Association (CWMA) Interim Meeting
The Lodge
Bettendorf, Iowa
Contact: Julie Quinn, 651-215-5823, jquinn@state.mn.us

26 – 27

MA State Weights & Measures Association Meeting & NIST Price Verification Training
Royal Plaza and Trade Center (Best Western)
Marlboro, MA
Contact: Steve Agostinelli, 508-862-4669, Steve.Agostinelli@town.barnstable.ma.us

25 – 29

Retail Computing Scales Regional Training
Findlay, OH
Contact: Ken Wheeler, 614-728-6290, kwheeler@mail.agri.state.oh.us

Vehicle-Tank & Loading-Rack Meter Training Class
Madison, WI
Contact: Tina Butcher, 301-975-2196, tina.butcher@nist.gov

26 – 28

NTETC Weighing Sector Annual Meeting
Radisson Hotel Annapolis
Annapolis, MD
Contact: NCWM, 240-632-9454, ncwm@mgmtsol.com

OCTOBER

2-3

Basic NIST Handbook 44 & Retail Computing Scales Class
Chicago, IL
Contact: Rick Harshman, 301-975-8107, richard.harshman@nist.gov

2 – 4

NIST Handbook 133 Training
Stoney Creek Inn & Conference Center
Onalaska, WI
Contact: Jim Richter, 920-832-6429, jim.richter@appleton.org

2 – 6

Retail Computing Scales Regional Training
Wilmington, OH
Contact: Ken Wheeler, 614-728-6290, kwheeler@mail.agri.state.oh.us

10 – 11

Northeast Weights & Measures Association (NEWMA) Interim Meeting
Best Western Albany Airport Inn
Albany, NY
Contact: Bill Timmons, 781-393-2463, mwtimmons@medford.org

18 – 19

NTETC Software Sector Meeting
Radisson Hotel
Annapolis, MD
Contact: NCWM, 240-632-9454, ncwm@mgmtsol.com

20 – 21

NTETC Measuring Sector Annual Meeting
Radisson Hotel Annapolis
Annapolis, MD
Contact: NCWM, 240-632-9454, ncwm@mgmtsol.com

22 – 23

NISA AREMA Committee 34 (railroad committee 34 scales)
Sheraton Gunter Hotel
San Antonio, TX
Contact: Bill Barbera, 847-367-6650
x155, WJBarbera@SystemsAssoc.com or
ISA@SystemsAssoc.com

NOTE: Cut-off date for guaranteed reservations is **9/21/06**.

23 – 24

National Industrial Scale Association (NISA) 20th Annual Fall 2006 Technical Conference (www.nisa.org)
Sheraton Gunter Hotel
San Antonio, TX
Contact: Bill Barbera, 847-367-6650
x155, WJBarbera@SystemsAssoc.com or
ISA@SystemsAssoc.com

NOTE: Cut-off date for guaranteed reservations is **9/21/06**.

22 – 25

Southern Weights & Measures Association (SWMA) Annual Meeting
Annapolis, MD
Contact: Will Wothlie, 410-841-5790,
wotthlrw@mda.state.md.us

29 – November 3

Combined Regional Metrology Meeting
Omni Hotel
Broomfield, CO
Contact: Georgia Harris, 301-975-4014
**Regional break-out meetings to discuss round robins will begin on Sunday afternoon and finish on Friday morning with round robin planning and business sessions.

NOVEMBER

13 – 17

Retail Computing Scales Regional Training
Akron, OH
Contact: Ken Wheeler, 614-728-6290,
kwheeler@mail.agri.state.oh.us

14 – 16

Scale Manufacturers Association (SMA) Fall Meeting
El Dorado Hotel & Spa
Santa Fe, NM
Contact: Bob Reinfried, 239-514-3441,
bob@scalemanufacturers.org

DECEMBER

4 – 8

Basic Mass for Industry
NIST, Gaithersburg, MD
Contact: Val Miller, 301-975-3602
Applications at: <http://www.nist.gov/lab-metrology>

Retail Computing Scales Regional Training
Reynoldsburg, OH
Contact: Ken Wheeler, 614-728-6290,
kwheeler@mail.agri.state.oh.us

11 – 15

Intermediate Metrology Seminar
NIST, Gaithersburg, MD
Contact: Val Miller, 301-975-3602
Applications at: <http://www.nist.gov/lab-metrology>

2007

JANUARY

21 – 24

NCWM 92nd Interim Meeting
Omni Jacksonville Hotel
Jacksonville, FL
Contact: NCWM, 240-632-9454 or
www.ncwm.net

22 – 26

Measurement Science Conference
Long Beach Convention Center
Long Beach, CA
Contact: MSC, (866) 672-6327,
www.msc-conf.org

FEBRUARY

26 – March 2

Advanced Mass Seminar
NIST, Gaithersburg, MD
Contact: Val Miller, 301-975-3602
Applications at: <http://www.nist.gov/lab-metrology>

APRIL

17 – 19

Scale Manufacturers Association (SMA) Annual Meeting
Crowne Plaza Hilton Head Island & Beach Resort
Hilton Head Island, SC
Contact: Phil Hannigan, 239-514.3441 x12,
phil@scalemanufacturers.org

29 – May 2

2007 Central Weights & Measures Association (CWMA) Annual Meeting
Crowne Plaza North,
Minneapolis, MN
Contact: Julie Quinn, 651.215.5823,
julie.quinn@state.mn.us

MAY

14 – 17

Northeast Weights & Measures Association (NEWMA) Annual Meeting
Springfield Marriott
Springfield, MA
Contact: Bill Timmons, 781-393-2463,
mwtimmons@meford.org

JULY

8 – 12

NCWM 92nd Annual Meeting
Snowbird Resort
Salt Lake City, UT
Contact: NCWM, 240-632-9454 or
www.ncwm.net

29 – August 2

NCSL International Workshop & Symposium
St. Paul Rivercentre
St. Paul, MN
Contact: NCSLI, 303-440-3339 or
www.ncsli.org

For meetings and events for the **American Petroleum Institute (API)**, please check the API website at www.api.org and click on the Meetings and Training Section under the “Energy Professional Site” bullet on the left-hand portion of the home page. Information for **American Society for Testing and Materials (ASTM)** meetings is available at www.astm.org on their Internet website. Click on the “Meetings” bullet on the left-hand portion of the home page. These meetings and seminars are updated on a continuous basis.

For information regarding **American National Standards Institute (ANSI)**, click on the “Meetings and Events” bullet on their website at www.ansi.org. For information regarding the National Conference on Weights and Measures (NCWM), please check the NCWM website at www.ncwm.net.

If you want your meeting, conference or training session included in the Calendar of Events, please contact Lynn Sebring, 301-975-4006 (email: lynn.sebring@nist.gov).